U.S. Department of Agriculture Science and Education Administration
June 1981

Agricultural Research

The Team Approach to Agricultural Research

Each year the U.S. Department of Agriculture honors its own—those men and women who contributed distinguished and superior service, through their work and achievements, to agriculture. This year 62 individuals and 16 groups received the Department's highest awards from Secretary John R. Block on May 28. Of those honored, four individuals and four groups were from SEA-AR.

These people are representative of the dedicated SEA-AR team across the country—the scientists, engineers, and staff who work to meet the research needs of USDA and the agricultural community. The four individuals honored for their contributions to the mission of SEA-AR are:

Warren C. Shaw, National Research Program Leader, National Program Staff, Beltsville, Maryland

Distinguished Service Award "For creative leadership and contributions to national agriculture in research and administration, carrying out SEA-AR responsibility and Departmental policy in developing weed control and agricultural chemical technology and basic weed science research that resulted in improved production and lower cost of food and fiber."

Virgil A. Johnson, Research Agronomist, Lincoln, Nebraska

Distinguished Service Award "For research on breeding wheat for nutrition and yield that has improved wheat as a food worldwide."

Edward W. Baker, Research Entomologist, Beltsville, Maryland

Superior Service Award "For pioneering research on mite classification, intensive research on the systematics of plant-feeding mites and exemplary international leadership in acarology."

Dean F. Davis, Research Director, Gainesville, Florida

Superior Service Award "For exceptionally high caliber and sustained superior performance in all duties as Research Director, Florida-Antilles Area, and in special assignments with regional and national scope."

The accomplishments of the four SEA-AR groups honored are diverse, but their approach to research is the same—effective teamwork. A brief summary of the achievements of each group follows:

Trickle Ammonia Research Team
Biomaterials Conversion Laboratory
Peoria, Illinois

Research Leader: Rodney J. Bothast

Team Members: Roy A. Anderson, Edgar B. Bogley, Clifford W. Hesseltine, E. B. Lancaster, Gerald W. Nofsinger, Richard T. Ross.

Distinguished Service Award "For initiative, creativity, and effective teamwork in discovering and developing the Trickle Ammonia Process, which will save fuel, improve feed quality and safety, and greatly reduce the costs of drying wet corn while protecting it from mold."

More than 75 percent of the Nation's corn crop is harvested while moist. With the uncertain availability and high cost of petroleum-based fuels, a concentrated effort is focusing on development of alternatives to present high-temperature corn drying methods.

On-farm scale experiments by the research team on high-moisture corn from three crop years indicate that producers can use the Trickle Ammonia Process (TAP) to successfully dry grain for animal feed.

The advantages of the new process are many. TAP supplies farmers with a simple, low-cost, energy-saving means to dry corn over long periods without the need for petroleum-based fuels. Most farmers have the facilities and equipment to use this process, as well as knowledge and experience in handling ammonia.

TAP will control microorganisms, including those that are toxigenic, and will minimize corn quality deterioration.

The process is operable over a wide range of climates, particularly in the South, and can be readily incorporated into other existing low-temperature drying systems, including those powered by the sun and electricity.

Following EPA approval, the team announced through the media that the process was ready for farm use during the 1979 corn harvest. Information from the 1979 and 1980 corn harvests indicates the positive impact and acceptance of TAP by the agricultural community.

Nonpoint Source Pollution Modeling Team
Tifton, Georgia

Coordinator: Walter G. Knisel

Team Members: Maurice H. Frere, George R. Foster, R. A. Leonard, Arlind D. Nicks, Roger E. Smith, and Jimmy R. Williams.

Superior Service Award "For outstanding achievement in organizing and coordinating a multidisciplinary team culminating in the development of a nonpoint source pollution model—Chemical, Runoff and Erosion from Agricultural Management Systems (CREAMS)—an important tool for predicting the impact of land use and management on water quality."

Section 28 of The Clean Water Act of 1972 (PL 92-500) called for development of area-wide waste management plans. Despite significant advances in environmental modeling, by late 1976 no user-owner model had been developed.

Recognizing the expertise and facilities available in USDA for developing natural resource management models, a team of key SEA-AR researchers convened to design such a model under Dr. Knisel's leadership. Some 45 scientists at 24 locations across the country participated in the project. The charge to this group was to develop a model that would have national applicability, be economical to use, and be readily adaptable by federal, state, and local agencies.

In three years, the team's primary goal was achieved with the May 1980 publication of the document "CREAMS, A Field Scale Model for Chemicals, Runoff and Erosion from Agricultural Management Systems." The model constitutes an operational tool for predicting the impact of land-use management practices on water quality and for assessing the

(Continued on page 16.)

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U.S. Department of Agriculture

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Administrator
Agricultural Research

Cover: This orange grove is part of Florida's $2-billion-per-year citrus industry. Although many commercial citrus orchards there suffered severe damage during last January's Florida freeze, SEA researchers in Orlando have developed new cold-resistant hybrids that withstood the low temperatures with little damage. (Photo courtesy of Grant Heilman.)

New Citrus Hybrid Beats Florida Freeze

Valencia, the major commercial orange variety grown in Florida, is one of the parent lines crossed with a cold-hardy desert lime, *Eremocitrus glauca,* to produce new cold-hardy hybrids. (Photo courtesy Grant Heilman.)

Florida citrus growers, who watched their orchards freeze during devastating 14°F temperatures last January, may find a glint of promise beneath the ice.

New cold-hardy hybrids developed by researchers at the SEA Horticultural Research Laboratory, Orlando, survived with little or no damage at the laboratory's A. H. Whitmore Foundation Farm near Leesburg, 40 miles away. Growing nearby, commercial varieties—such as Page mandarin hybrid, Pineapple orange, and Red grapefruit—suffered extensive fruit, leaf, and shoot damage.

The successful new hybrids resulted from crosses between *Citrus* and the cold-hardy *Eremocitrus glauca,* an evergreen relative from Australia, and between *Citrus* and *Poncirus trifoliata,* a cold-hardy tree from China that loses its leaves in winter.

"The *Eremocitrus* hybrids were evergreen while many of the *P. trifoliata* hybrids had dropped their leaves before the freeze," says plant physiologist Roger Young, director of the Orlando laboratory. "These hybrids are now being used to hybridize or backcross with citrus, such as sweet orange and grapefruit, to develop more cold-hardy varieties."

"Now we also have some second generation hybrids—*Citrus* crossed with hybrids of *P. trilofiata* by *Citrus*—which produce fairly good fruit, and are more cold-hardy than the *Citrus* parent. This has never been accomplished before in citrus breeding, and is very exciting."

The excitement began to generate in 1978, when plant physiologist George Yelenosky, research geneticist Herbert C. Barrett, and Young reported that "*Eremocitrus* may be a useful source of cold hardiness for breeding cold-hardy citrus hybrids."

Eremocitrus glauca, Australian desert lime, is a relative of *Citrus.* The species is indigenous to the semi-arid regions of Australia where drought and both high and low temperatures are common. In Australia, *Eremocitrus* has a pronounced period of dormancy.

In earlier studies by SEA researchers, hybrids were obtained from hand-pollinations of *E. glauca* with pollen of Valencia and Koethen sweet orange, Sicilian sour orange, and Nagami kumquat. Budwood of available hybrids and the parental types was propagated on cold-sensitive rough lemon rootstock and grown outdoors. Controlled freeze studies began with 6 consecutive weeks of cold-hardening temperatures immediately before testing. Six weeks after freeze tests, at least five trees per selection were available and rated on average leaf and stem kill.

Eremocitrus wood was not injured during a subsequent severe freeze in the field, but stem kill of other available hybrids ranged from 12 to 54 percent. The most cold-hardy selections were those between *E. glauca* and Valencia orange.

All of the *Eremocitrus* hybrids were 2 to 3 weeks later in spring bud-break than were the *Citrus* parents, indicating that cultivars exhibiting late bud-break tended to be more cold hardy than cultivars with early bud-break.

"Many of us think *Eremocitrus* offers advantages over *P. trifoliata* in breeding for cold hardiness," says Barrett. "Most *Eremocitrus* hybrids start growth later than the *P. trifoliata* hybrids. This helps the trees remain dormant during occasional warm growing periods in mid-

Top: Even one of Florida's most cold-resistant commercial citrus varieties, Page orange, left row, was unable to escape heavy damage during the freeze. However, the row of *Eremocitrus* hybrids on the right shows little damage from the freeze (0581X478-4a.)

Above: For a closer comparison of the two varieties' cold-hardiness, Roger Young, SEA plant physiologist, examines tree limbs of Page orange, left, and an *Eremocitrus* hybrid one month after the freeze (0581X481-20a).

Above. At the Orlando lab, Herbert C. Barrett, SEA research geneticist who performed the cross-pollinations between *Eremocitrus and Citrus,* examines leaf characteristics of a hybrid plant (0581X479-10.)

Right. After the thaw, *Eremocitrus* hybrid produces new fruit. Less resistant varieties damaged severely during the freeze will not produce at their pre-freeze capacity for 2 to 4 years (0581X481-9a).

winter. Also, the fruit of *Eremocitrus* tastes better than fruit of *P. trifoliata,* and their respective first-generation hybrids produce fruit with taste characteristics similar to *Eremocitrus* and *P. trifoliata,* respectively. Now we hope to achieve second-generation crosses that produce good fruit."

The scientists found that the first-generation *Eremocitrus* hybrid fruit was too small and acid to be commercially acceptable.

The challenge for research: to breed second-generation *Eremocitrus* hybrids that produce commercial quality fruit on trees that are more cold-hardy than the *Citrus* parent.

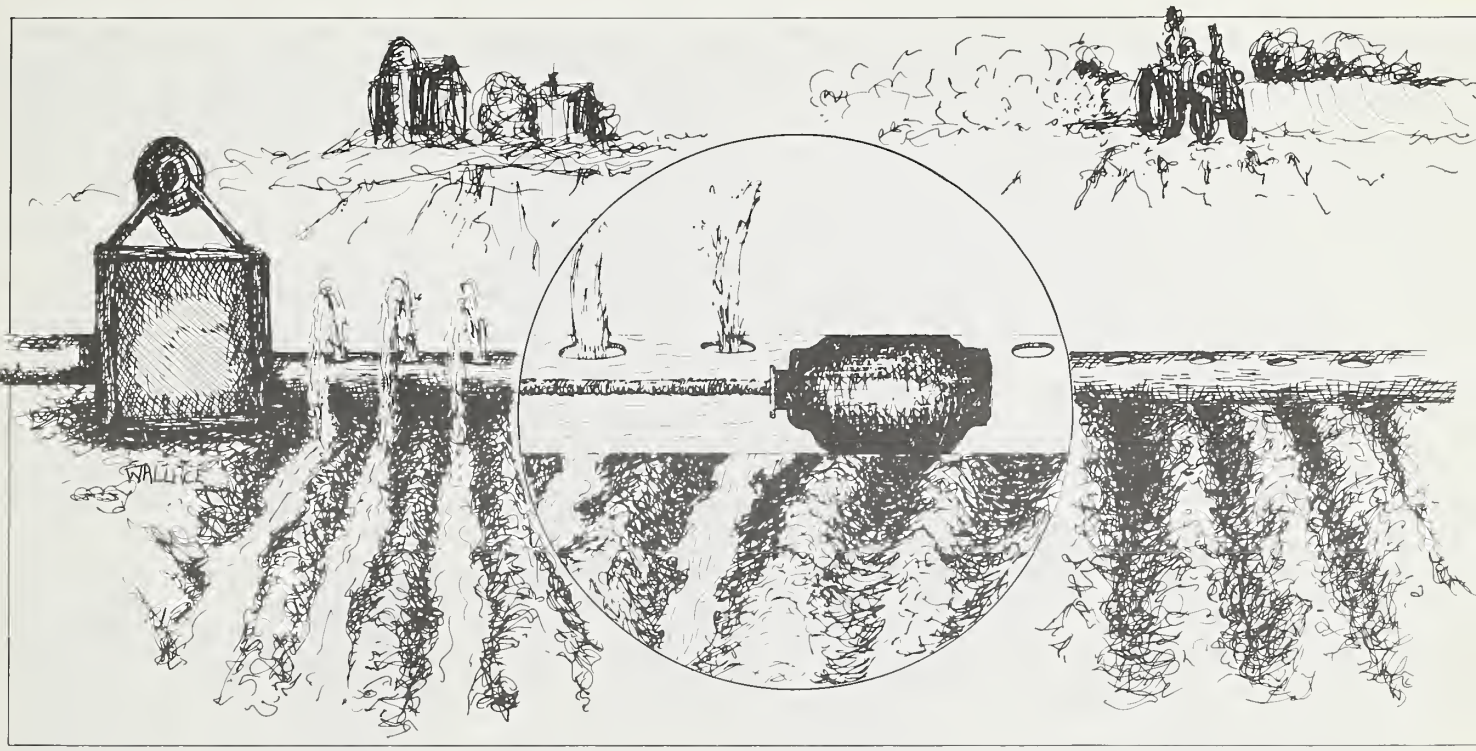
Hardy Satsuma, Changsha, and King mandarins hybridized at the Foundation Farm since 1959 produced progeny that also survived the 1981 freeze with little damage. These progeny produce acceptable fruit that are ripe by early winter and therefore evade freeze injury. These hybrids within the genus *Citrus* are not as cold hardy as hybrids involving *Eremocitrus* and *Poncirus,* but the taste of their fruit is more acceptable. This is an alternative method of breeding for cold hardiness within edible types.

Barrett and geneticists Donald J. Hutchison and C. Jack Hearn are currently conducting the breeding work at the Foundation Farm. Since 1959, citrus scion and rootstock cultivar improvement research has culminated in the successful Page, Nova, Robinson, Lee, and Sunburst scion cultivars and Swingle citrumelo rootstock, all of which have been released to the citrus industry.

This research is part of a wide-ranging USDA program to improve disease, insect, and cold resistance, and increase yields of quality fruit.

Drs. Roger Young, Herbert C. Barrett, Donald J. Hutchison, C. Jack Hearn, and George Yelenosky are located at the U.S. Horticultural Research Laboratory, 2120 Camden Road, Orlando, FL 32803.—(By Peggy Goodin, SEA, New Orleans, La.)

Cablegation—New Surface Irrigation System



Cablegation—an energy-efficient, relatively inexpensive, and easily operated irrigation system—is well-suited for family farms. SEA's experimental version of cablegation is powered by a 12-volt auto battery, and the "cable" is a 120-pound test fish line.

A new, energy-saving, automatic surface irrigation system called "cablegation" has been designed by SEA researchers for farmers who need a low-cost alternative to sprinkler systems.

The cablegation system uses gravity to deliver water to furrows automatically and sequentially. It was developed by W. Doral Kemper, director, William H. Heinemann, machinist-foreman, and their coworkers at the SEA Snake River Conservation Research Center, Kimberly, Idaho. The cablegation system costs less to install than a sprinkler system and its energy requirement is less than 10 kilowatt hours per year.

Since sprinkler irrigation systems tend to provide more uniform water applications and require less time than most surface irrigation systems, many farmers have switched to this irrigation method. However, the energy required to pump water through a sprinkler system generally accounts for more than half the energy used on a farm.

Kemper says that by combining the energy efficiency of gravity-flow surface irrigation with uniform water applications that approach those of sprinkler systems, the cablegation system offers farmers the best of both methods.

The new system consists of a single pipe that is large enough to carry the amount of water an individual grower needs for good irrigation without running more than 90 percent full when the flow of water is unimpeded. On the side of the pipe that faces the furrows, 30 degrees from the top, one hole is drilled for each furrow. (See accompanying art.)

Inside the pipe is a bowl-shaped polyethylene plug attached to a reel by a "cable." The rate at which the reel feeds out the cable and allows water to push the plug through the pipe is governed by a geared-down electric motor and clocking device.

The plug stops the forward motion of water passing through the pipe. As pressure mounts near the plug, water fills the pipe and is forced out of the holes and into the furrows.

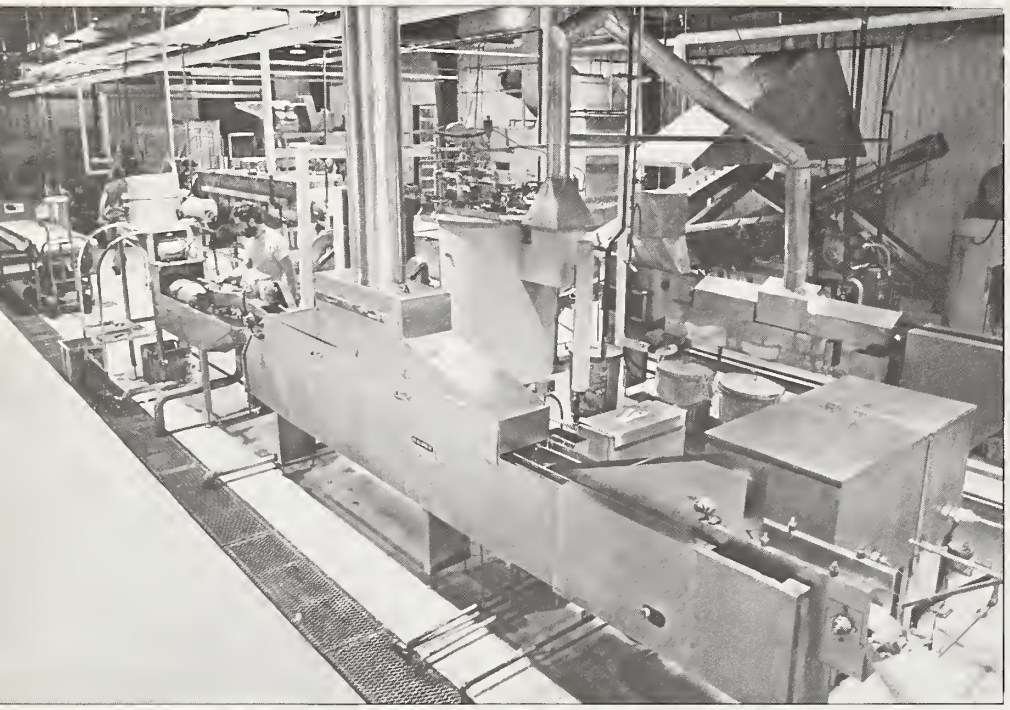
As the plug moves through the pipe from the top of the field, each furrow in turn gets an initially high rate of flow that gradually diminishes to zero. Controlling the rate at which the plug moves allows furrows to be irrigated for the desired length of time.

"So far our field tests have been successful," says Kemper. "We've set up the system, left it to run as long as 50 hours, returned and found the job done with no problems. We lose about 1 percent of our water to seepage around the plug, but the rest is pushed out of the pipe and into the furrows as desired."

Local farmers are already requesting information concerning costs and installation of the cablegation system from the researchers.

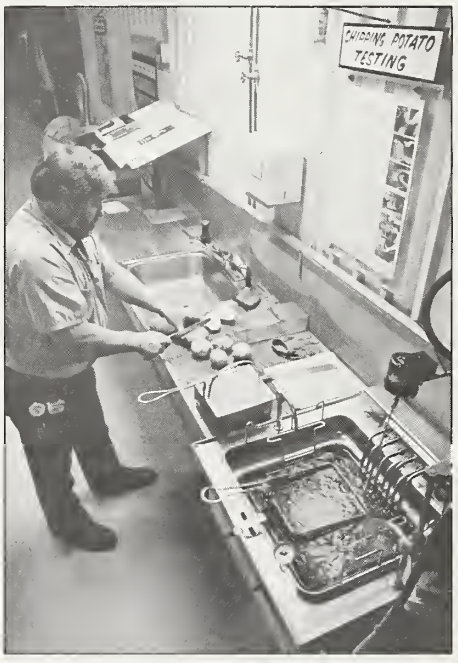
Dr. Kemper and Mr. Heinemann are located at the SEA Snake Conservation Research Center, Route 1, Box 186, Kimberly, ID 83341.—(By Lynn Yarris, SEA, Oakland, Calif.)

Modern Potato Chips Absorb Less Oil



Top: This pilot-scale version of a commercial potato chip plant enables researchers from SEA, North Dakota State University, and the University of Minnesota at St. Paul to observe, under near-commercial production conditions, chipping quality of new potato crosses in variety development programs. Technician Douglas Bouvette monitors chip production process (0281X165-10).

Above: Local growers can test their own potatoes in back of the pilot plant. Potatoes are weighed in air and then in water to determine specific gravity—a measure of moisture and dry matter content. Those with high specific gravity—low moisture content—yield more chips per weight of potato and absorb less oil than do those with low specific gravity (021X168-5).



Above: After weighing potatoes, John Gervais—maintenance mechanic who helped construct this test facility for local growers—slices potatoes for frying in the "chipper dipper," foreground, as it is affectionately called in the lab (0281X168-22).

Advances in agricultural and food processing technology could lower the calories and production costs soaked up by the average potato chip.

"We're learning to appreciate the value of potatoes with low-moisture content," says SEA research chemist Edward C. Lulai of the Red River Valley Potato Research Laboratory in East Grand Forks, Minn.

Because potato-chip frying is essentially a drying process, chips made from high-moisture potatoes must be cooked longer. That means a larger energy bill for the food processor. In addition, cooking oils in which chips are fried can be expensive, and high-moisture potatoes absorb more oil and, thus, more calories than low-moisture potatoes.

Potatoes with high specific gravity—a measure of relative moisture and dry-matter contents—yield a greater percentage of their weight in chips than do potatoes with low specific gravity.

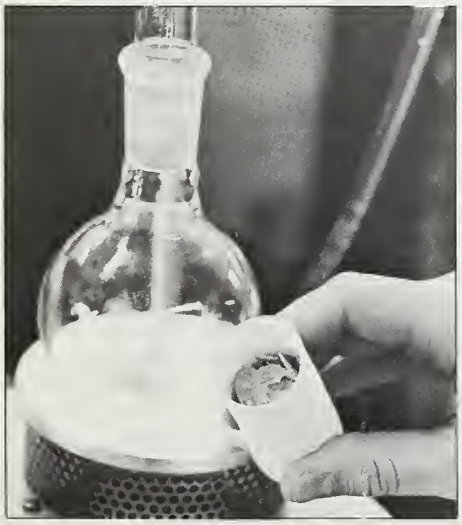
Using a computer, Lulai and agricultural engineer Paul H. Orr derived mathematical equations predicting the chip yield and chip oil content for potatoes of any given specific gravity. The researchers obtained data for the equations from chipping experiments in a pilot plant at the laboratory.

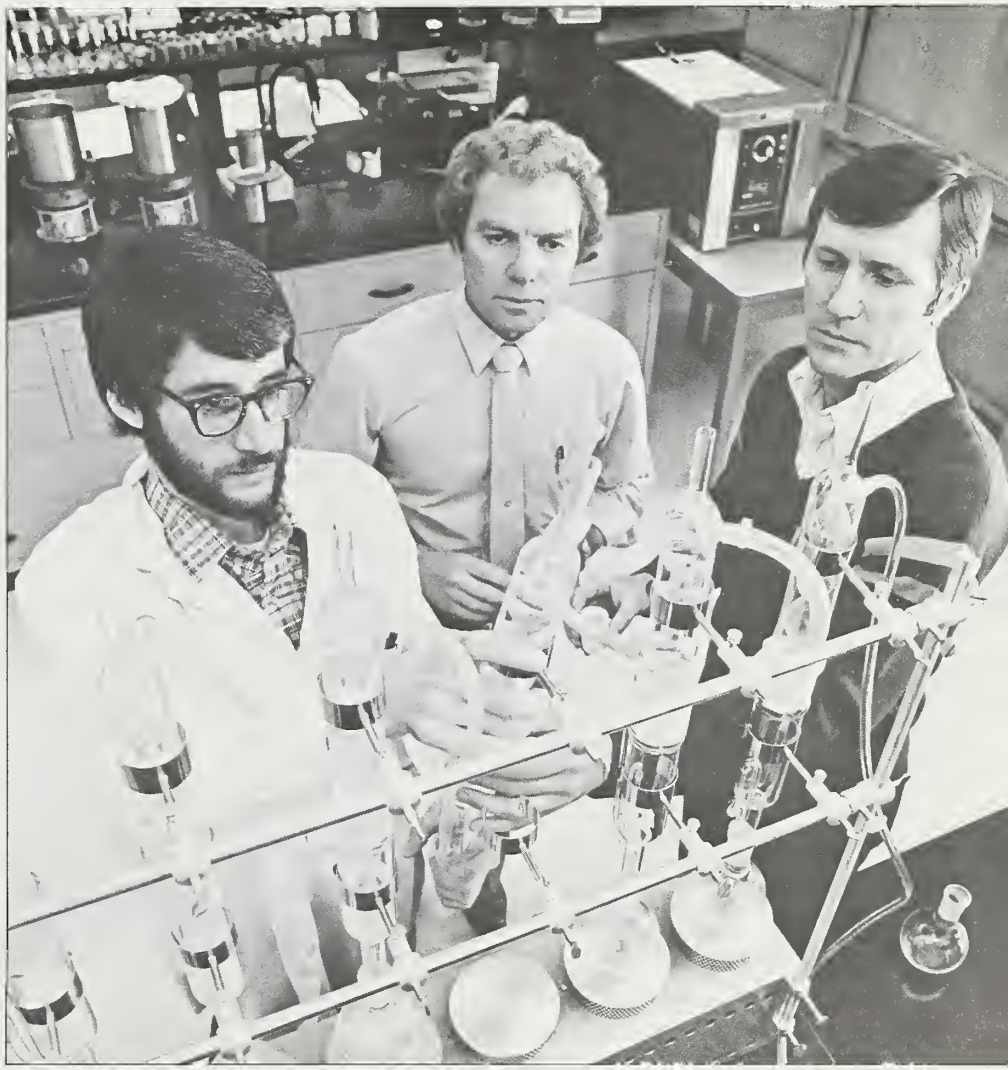
Potatoes with a specific gravity as low as 1.06 yielded only 28 percent of their weight in chips. In contrast, potatoes with a specific gravity as high as 1.11 yielded more than 36 percent of their weight in chips and contained 28 percent less oil than chips from potatoes with a lower specific gravity.

The researchers also determined how many potatoes must be tested from a potato lot of a given size to obtain a statistically reliable specific gravity measurement.

Specific gravity of potatoes may vary according to the agronomic conditions under which the tubers are grown. Well-balanced soil fertility and good moisture management enhance the specific gravity.

Also, some varieties have consistently higher specific gravity than others. In the spring of 1980, researchers at North Dakota State University, Fargo, and the Red River Valley Potato Research





Laboratory announced the development of a new potato variety, Crystal, which in 6 years of testing averaged nearly 10 percent higher in dry-matter content than a popular variety, Kennebec. Therefore, Crystal would produce a higher percentage of chips per pound of potato than Kennebec.

As potato breeders at North Dakota State University and the University of Minnesota, St. Paul, develop new breeding lines, they routinely send samples to the Red River Valley Potato Research Laboratory for evaluation of processing qualities.

Dr. Edward C. Lulai and Dr. Paul H. Orr are located at the Red River Valley Potato Research Laboratory, 3 ifth Avenue NE, PO Box 113, East Grand Forks, MN 56721.—(By Ben Hardin, SEA, Peoria, Ill.)

Above: Chips from potatoes with low specific gravity absorb more oil and thus have more calories. Lab technician Mike B. Shea, left, tests chips for oil content as Paul H. Orr, center, SEA agriculture engineer, and Edward C. Lulai, SEA research chemist observe (0211X167-24).

Top left: Gervais displays chips after frying. They are checked for color quality, giving growers an estimate of how their potatoes will perform commercially (0211X167-19a).

Center left: Bouvette measures amount of light reflecting off finished chips to see if they meet color quality standards (0281X163-5).

Lower left: To measure oil content, researchers crushes chips and puts them in cellulose thimble. Solvents are added for oil extraction and then are evaporated—leaving pure oil to be measured (0281X167-35).

Science on the Western Range

A Nevada ranch is the working laboratory for a long-term study that researchers expect will lay a new scientific base for grazing livestock on sagebrush lands in the West.

Researchers say the study's results may be applied directly to some 100 million acres of sagebrush lands in the 11 western states, and could offer insights into grazing practices on about 200 million acres of other western rangelands.

"We need to see the total picture of cattle grazing and find out what grazing practices are suited to the land—from both environmental and economic standpoints," says the principal investigator, Richard Eckert, Jr., a SEA range scientist located at Reno.

Eckert says that this is the first long-term study of its size to examine what happens to soil, vegetation, water resources, and wildlife where cattle graze sagebrush lands. Seven state and federal agencies and the Nevada Cattlemen's Association are cooperating in the study.

According to Jeanne Edwards, who volunteered her Saval Ranch near Elko in northeastern Nevada for the study, rangeland throughout the West "will continue to face increasing pressures for use—for oil shale, coal, minerals, and lumber, and as a place for hikers and skiers. It is imperative that the sciences come into play in finding ways for rational land use."

Edwards has invited researchers to study her ranch of 59,000 acres and 1,200 head of breeding stock. The study area comprises about 45,000 acres of leased federal land and about 14,000 acres that are privately owned.

Active in the Society for Range Management and the American Forestry Association, Edwards was named "Range Man of the Year" in 1979 by the Nevada Section of the Society for Range Management.

Eckert says it will be no surprise, in the study, to find cowboy and scientist riding the Saval range together. "We're not going to overlook the rancher's own conservation experiences that have paid off in protecting the land," he says.

Owner Edwards says that the resources of the range "can be managed to work together, not at cross purposes, but it will take credible scientific findings and some workable new ideas that ranchers can adapt to their own needs for an economically viable cattle operation."

As Eckert sees it, the study will "go a long way toward identifying how and where rangeland can reach its potential, in economic and environmental terms, for raising cattle as a food source."

David Secrist of North Fork, president of the Nevada Cattlemen's Association, says that new grazing patterns, uses of forage, and other range improvements may make it possible to increase—perhaps double—the meat production of beef herds in the years ahead.

"We are not looking for short-term answers to grazing problems," says Eckert. "The 10 or more years going into this study will take us through an interim period and one full grazing cycle of intensive management, giving us the broad research base that is needed."

Specific research phases of the study will begin on the ranch in the spring of 1981, according to Eckert. The first stage of the study—a 3-year inventory of the Saval's natural resources—was completed in 1980.

Multidisciplinary studies will be emphasized, and they will involve federal and state researchers from SEA, Forest Service (the Intermountain Forest and Humboldt National Forest), Soil

Conservation Service (all of USDA), the Bureau of Land Management and Geological Survey of the Department of Interior; the Nevada Department of Wildlife; and the College of Agriculture of the University of Nevada-Reno.

Scientists and ranch hands will study the trout and water in the streams, the native plants and trees, and the food and cover for mule deer, sage grouse, and other wildlife as carefully as they study the cattle on the ranch, Eckert says. As grazing practices are worked out, researchers will use monitoring systems precise enough to detect changes in the land's resources.

A working paper prepared as a timetable for the research outlines some goals and activities:

- Increase the growth of forage plants, thus reducing the amount of grain needed as cattle feed and freeing more grain for human consumption.
- Safeguard streams for trout and other wildlife.
- Develop grazing schedules and alternate grazing sites that will produce maximum environmental and economic benefits.
- Study grazing habits of deer and other wildlife in order to establish cattle grazing schedules in which cattle and wildlife are not competing for forage.
- Measure the effects of grazing on streamflow, water chemistry, sediment runoff, and soil water infiltration.
- Determine the nutritional carrying capacity of large-range sites for livestock and wildlife.
- Reduce soil loss on grazed lands.

Eckert says that findings from these and other studies will be used to evaluate the economic and social benefits and to determine the costs and benefits of range management systems that will be worked out in the study.

Asked how she could afford to provide her land, cattle, and the time and experience of her ranch personnel for the study, Saval Ranch owner Edwards answered, "How can I afford not to?"

Dr. Richard Eckert, Jr., is located at the SEA Renewable Resource Center, University of Nevada, 920 Valley Road, Reno, NV 89507.—(By Isabel Duffy, SEA Information, Washington, D.C.)

Opposite: Jeanne Edwards, right, has invited Richard Eckert, Jr., SEA range scientist, and other researchers to study grazing management of western sagebrush land on her 59,000-acre Saval Ranch in Nevada (0480X453-8).

Above: Michael Ralphs, Saval Ranch manager, rounds up part of the herd being monitored in the study (0480X452-9).

Left: Inspecting a topographic mock-up of the study area are, from left, Floyd Kinsinger, executive secretary, Society for Range Management; Joe Farrell, president, Freeport Gold Co.; Jeanne Edwards, ranch owner; and David Secrist, president, Nevada Cattlemen's Association (0480X456-8).

Simple Test for Nutrition of Pregnant Ewes

A simple test used by diabetics to determine the level of ketones in their urine can help sheep producers determine if gestating ewes are getting adequate nutrients.

According to SEA animal physiologist G. Paul Lynch of the Ruminant Nutrition Laboratory, Beltsville, Md., when gestating ewes are not getting enough feed to meet their nutritional requirements, they use reserve body fat. When this happens, ketones show up in their blood and urine. This can usually be corrected by providing ewes with more feed.

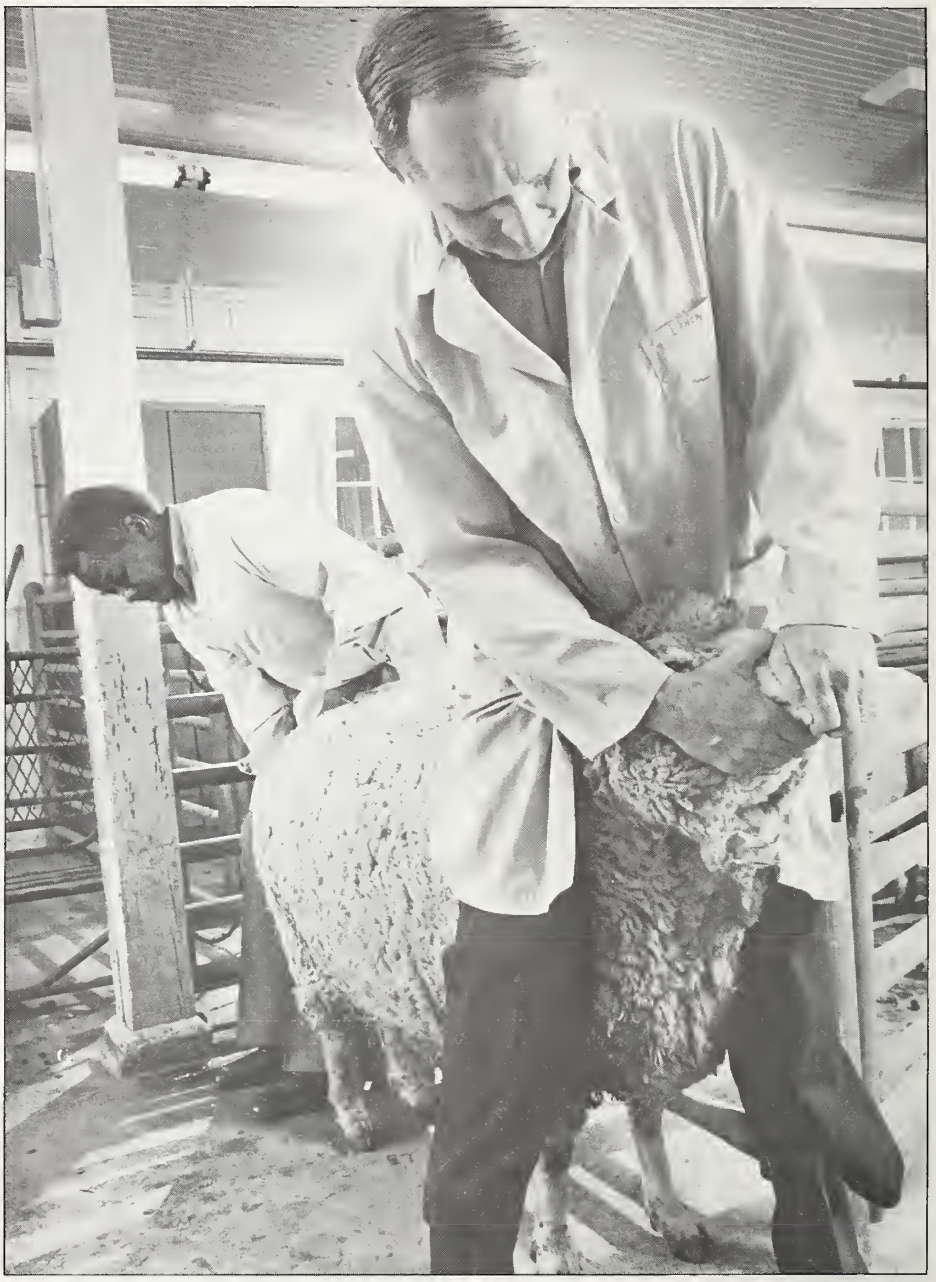
Lynch points out that the trend in sheep production in recent years has been to produce three lamb crops in 2 years and to use breed crosses with a high rate of multiple births. "A ewe carrying two or more fetuses has greater nutritional requirements than one carrying a single fetus," the researcher says. In one experiment, about half the lambs of underfed ewes carrying multiple fetuses were born underweight or dead."

With small flocks, it may be possible to separate ewes based on the results of the ketone test, and give extra feed only to those ewes who need it—usually, those with multiple fetuses. Owners of larger flocks may be able to test a few ewes to determine the general nutritional status of their flock.

Obtaining urine samples is a simple procedure that is best done by two persons, Lynch says. One person holds a hand over the ewe's nostrils to temporarily cut off her breathing. This makes her nervous. In response she will urinate. The second person can then collect the urine sample. About a tablespoonful is all that is needed for the test.

The ketone test may be especially useful to owners of flocks who carefully manage their animals for maximum lamb production. Ketone test kits are available at local pharmacies.

Dr. G. Paul Lynch is located at the Ruminant Nutrition Laboratory, Room 118, Building 200, Beltsville, MD 20705.—(By Henry Becker III, SEA Information Staff, Washington, D.C.)



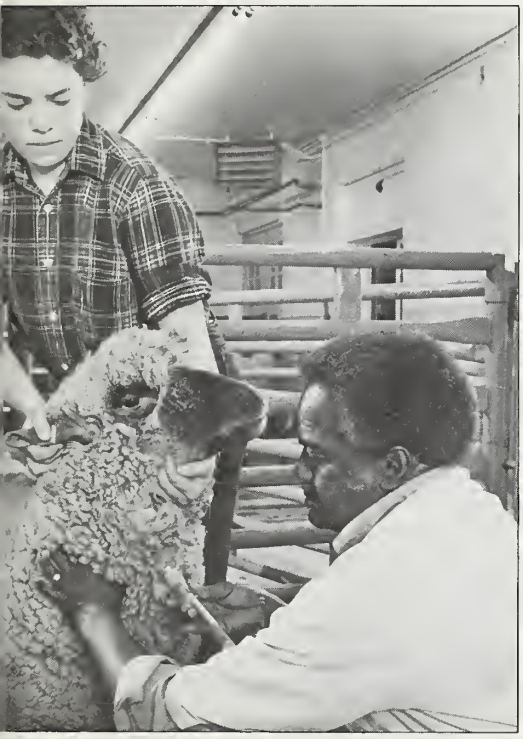
Above: To obtain sample from this pregnant ewe, C. Paul Lynch, animal physiologist, blocks breathing while Charlie Jackson, Jr., agricultural research technician, collects specimen. Ketone level in urine will indicate if this ewe is receiving proper nutrition during pregnancy (0481W359-9a).

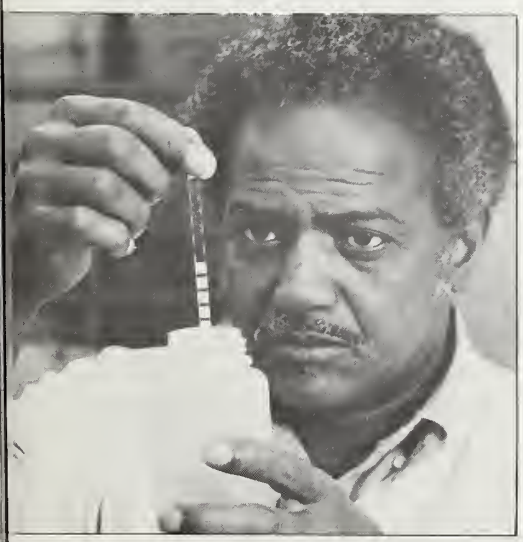
Opposite top: Blood can also be measured for ketone levels. Jackson draws blood from ewe's neck as Ann Bryan, livestock aide, holds her still (0481W359-26a).

Opposite center: Research in Beltsville shows that pure stands of fescue, a widely used pasture grass, causes delayed conception in ewes. Lynch identifies ewes kept in this fescue plot for hormone tests to determine the specific effect of fescue on their reproductive cycle (0581X556-4a).

Opposite below: Jackson tests ketone level in urine specimen. White squares on test stick will turn purple if ketone is present, indicating the ewe is using reserve body fat at a rapid rate. A positive ketone test shows that the ewe needs more food (0481W368-4a).

Affordable Sewage Disposal for Rural Communities





A newly developed low-cost disposal system makes sewage treatment affordable for small rural communities. In some rural areas, poor soil conditions or high water tables inhibit the infiltration and percolation of wastewater. Conventional onsite disposal is unsafe in such areas, but many small communities find the costs of installing big gravity lines and high technology treatment plants prohibitive.

One solution is onsite pretreatment and liquefication, reasonably priced transport lines, and a cost-effective central treatment facility. Such a system, developed by SEA researchers at the Rural Housing Research Unit, Clemson, S.C., now serves 31 homes in Mt. Andrew, Ala. The system consists of modified septic tanks, small-diameter poly-vinyl chloride (PVC) transport lines, and an oxidation pond for final treatment. Sewage is liquified in modified septic tanks called interceptor tanks. The interceptor tanks have two compartments separated by a wall. The first chamber (508 gallons usable volume) is the raw-sewage digestor. The next chamber (190 gallons) is the liquid storage section.

The two compartments of the interceptor tank are connected by six 2-inch-diameter PVC clarifier tubes that run through the separating wall. As the sewage flows through the tank, a low-velocity upward flow through the tubes allows the solids to settle and fall back into the digestor compartment. The 4-foot water level in the digestor is maintained by the height of the ends of the tubes protruding into the liquid section. The 3-foot water level in the liquid section is set by the height of the discharge line. The interceptor tanks produce effluent virtually free of solids, which can be removed with pressure or gravity sewers.

Effluent from the tanks is delivered to an oxidation lagoon. The lagoon, designed with help from the Alabama Water Improvement Commission, has a 1/3-acre surface area and a normal operating depth of 4 feet. This depth permits reasonable mixing of the water to maintain aerobic conditions, and allows penetration of sunlight for good algae growth; it is odor free. A 2-acre second basin was constructed as a detention or evaporation pond to handle any overflow from the lagoon.

At Mt. Andrew, the interceptor tanks at 13 houses are connected to a 3-inch gravity line, and those at 10 houses are connected to a 2-inch gravity line. Eight houses are below street level, and their effluent is pumped up to a 3-inch gravity line. The gravity lines were laid along the existing grade, independent of the elevation, at a cost of less than $2 per linear foot.

The 970-foot, 2-inch line is unique in that its slope changes from negative to positive before it reaches the lagoon. It performs well in transporting "septic tank" quality effluent to the lagoon.

According to researchers John D. Simmons, Jerry Newman, and Franklyn W. Adams, the system used at Mt. Andrew is easy to install, and performance has been trouble free. It provides adequate sewage disposal at an individual cost comparable to that of a conventional septic tank/drainfield system.

John D. Simmons and Jerry Newman are with the SEA Rural Housing Research Unit, P.O. Box 792, Clemson, SC 29631. Franklyn W. Adams is with Troy State University, Troy, AL 38081.—(By Eriks Likums, SEA, New Orleans, La.)

An Improved Reed Canarygrass Strain

Above: Characteristics that make this reed canarygrass undesirable for livestock grazing—including low palatability and high alkaloid content—have been improved in a new strain under study in Minnesota. (Photo courtesy of Grant Heilman.)

Opposite: Increased seeding rates can mean increased soybean yields in areas of expected herbicide damage. (Photo courtesy of Grant Heilman.)

Reed canarygrass may be moving up on the forage popularity charts, says Gordon C. Marten, SEA agronomist at St. Paul, Minn.

In 2 years of pasture tests lambs grazing on MN-76, a new strain of reed canarygrass, averaged gains of 0.26 pound per day. Lambs on Vantage and Rise, two older varieties, gained 0.18 and 0.15 pound per day, respectively.

"Reed canarygrass has never been widely accepted by farmers," Marten says. "It has long been criticized for its low palatability rating, and sometimes for its low weight gain potential with livestock and its apparent inducement of diarrhea in sheep."

Comparing diarrhea problems as well as weight gains, Marten noted incidence of diarrhea was at least four times as great for lambs grazing Rise as for those on Vantage or MN-76.

A basic problem with reed canarygrass has been its high alkaloid content. Alkaloids are complex compounds that serve no known function in plants, Marten says. Three alkaloids commonly found in reed canarygrass are gramine, tryptamine, and carboline. The latter two alkaloids seem to readily cause diarrhea and poor animal performance, while gramine seems somewhat more tolerable to livestock.

"Of the three reed canarygrasses tested, Rise is the only one containing tryptamines and carbolines," Marten says. "Average total dry weight for the 2 years showed that Rise contained 3,000 parts per million of alkaloids, Vantage 2,650 ppm, and MN-76 1,050 ppm. Vantage and MN-76 contained only gramine."

The researchers measured alkaloid concentrations of the grasses several times during the grazing seasons. They also measured nutritive value, crude protein, cell wall constituents, and mineral concentrations.

Forage quality was about the same for all three grasses except that MN-76 contained 6 to 8 percent less cell wall and as much as 9 percent more crude protein than did the two commercial varieties. MN-76 was also higher in calcium than was Rise and Vantage. Grass hays are often deficient in calcium, so the increased calcium in MN-76 should be considered a plus factor, Marten says.

Lambs grazed the plots for 56 days the first year and 61 days the second year. Three pastures were seeded to each of three replications of the grasses tested, 0.67 acres each. After one hay crop was removed each year, 5 to 10 lambs were maintained on each pasture, depending on the carrying capacity (grazing pressure was controlled).

Reed canarygrass is a high-yielding and very adaptable pasture, hay, and silage crop. It grows in a great variety of soils and under both wet and dry conditions, Marten says. Total acreage planted to reed canarygrass should increase substantially with release of palatable, low alkaloid varieties.

"Successful breeding of low alkaloid varieties of reed canarygrass very likely will mean increased farm income without increased costs to the farmer," Marten says. He thinks such varieties will be available within a few years.

Marten has been working with University of Minnesota animal scientist Robert M. Jordan and plant geneticist Arne W. Hovin, trying to identify and evaluate the negative characteristics of reed canarygrass and remove them through a breeding program.

Dr. Gordon C. Marten is located at Rm. 404, Agronomy Bldg., University of Minnesota, St. Paul, MN 55108.—(By Ray Pierce, SEA, Peoria, Ill.)

Increased Soybean Seeding Overcomes Herbicide Effects

Increased soybean seeding rates reduced detrimental effects of atrazine and metribuzin herbicides on soybean yields during a 2-year study by Robert N. Andersen, research agronomist at St. Paul, Minn.

"Soybeans can be severely damaged by atrazine carryover from application on corn the previous growing season," Andersen says. "In the case of metribuzin, soil applications are commonly made for weed control in soybeans and the margin of safety is not great. High rainfall can increase injury from both herbicides."

Results of the 1978 and 1979 tests suggest that a grower using wide rows would increase the probability of higher yields if he increased seeding rates in fields where he expects a problem with atrazine carryover or where metribuzin might be expected to cause damage," Andersen says.

Andersen conducted the research on plots at the University of Minnesota Agricultural Experiment Station, Rosemont. Herbicides were disked into the soil in late May and soybeans were planted the following day in both years. Three application rates were tested for both herbicides—½ pound, 1 pound, and 1½ pounds per acre.

Three seeding rates were tested: a normal rate of 60 pounds per acre, and higher rates of 90 and 120 pounds per acre.

In the 1978 tests, higher seeding rates improved yields, Andersen says. High rainfall levels for 6 weeks after planting probably increased herbicide injury.

When atrazine caused a problem at the rate of ½ pound per acre, as happened in 1978, the 60-pound seeding rate produced at 35.2 bushels per acre, the 90-pound rate at 40.5 bushels, and the 120-pound rate at 41.2 bushels.

Atrazine treatment reduced the plant population about 30 percent compared to untreated plots. Increasing the seeding rate by 50 percent brought the plant population back up to that of the nontreated plots, Andersen says.

In 1979 under dryer conditions, seeding rates did not affect yield significantly when atrazine was used at ½ pound per acre. However, at atrazine rates of 1 pound and 1½ pounds per acre, obvious benefits were gained by increasing the seeding rate.

Plots seeded normally at 60 pounds per acre, and treated at 1 pound of atrazine per acre, produced at 35.1 bushels. Plots treated with the same amount of atrazine and planted with 50 percent more seed yielded at 38.4 bushels and those where the seeding rate was doubled at 39.8 bushels.

Plots treated at ½ or 1 pound of metribuzin per acre in 1979 did not suffer sufficient yield reductions to benefit from increased seeding rates. But, at the 1½ pound rate, yield was improved by both the higher seeding rates. The normal 60-pound rate produced at 28.6 bushels, the 90-pound rate at 31.6 bushels, and the 120-pound rate at 35.4 bushels per acre.

Hodgson variety soybeans were used in the experiments and lodging was not a problem. Other varieties or different growing conditions might cause lodging with the higher seeding rates, Andersen warned.

These results support the theory that, for wide-row planting, increasing seeding rates will increase the probability of high yields from soybean crops in fields where herbicide problems are expected, Andersen concludes.

Dr. Robert N. Andersen is located at the University of Minnesota, Dept. of Agronomy, St. Paul, MN 55108.—(By Ray Pierce, SEA, Peoria, Ill.)

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The Team Approach to Agricultural Research

(Continued from page 2.)

benefits of implementing Best Management Practices (BMP's) for improved water quality.

Magnetic tapes of the computer model are readily available to users and can greatly assist planners in identifying critical source areas of pollution.

Preliminary studies indicate that the model can be readily adapted for use in managing strip-mined lands and for evaluating sediment and chemical releases from construction and waste disposal sites.

Citrus Insects Laboratory
Weslaco, Texas
Research Leader: William C. Hart and
Research Leader: Allen G. Selhime
Team Members: J. Caballero, C. R. Crittenden, C. A. Garcia, R. L. Garcia, S. J. Ingle, R. F. Kanarel, R. H. Rhode, and M. Sanchez-Riviello.

Citrus Insect Research Unit
U.S. Horticultural Research Laboratory
Orlando, Florida
Distinguished Service Award "For outstanding public service in developing rearing procedures for parasites of the citrus blackfly, releasing parasites in Florida and Texas, and demonstrating the feasibility of biological control of citrus blackflies.

These two groups cooperated in a successful biological control effort of the citrus blackfly in Florida—thus eliminating a serious threat to the state's $2-billion-a-year, 900,000-acre citrus industry.

The biological control program introduced a parasite of the blackfly and resulted in termination of a costly chemical spray program. Savings of $20 million were projected for the four additional years the spray program was scheduled to run.

In 1971, the Weslaco group initiated a project to develop an effective parasite rearing program in Mexico for the citrus blackfly. When high populations of citrus blackfly became established at Brownsville, Tex., more than 30,000 parasites per week were being produced at the rearing facility.

The remarkable success of the parasites in controlling this infestation eliminated the need for expensive spray applications, reduced environmental contamination, and controlled the pest without destroying beneficial insects.

In 1976, an outbreak of citrus blackfly was discovered near Ft. Lauderdale, Fla. By 1977, a spray program to eliminate the insect became a $5-million-per-year operation. The Orlando research team obtained suficient numbers of the parasites from the Weslaco group for introduction on infested trees in Florida.

During 1978, data on the effectiveness of the released parasites gained widespread recognition and the Florida regulatory agency began assisting with dispersal of the citrus parasites.

In January 1979, Florida was declared free of the destructive insect.

Nutrition, Sterility and Quality Control Research Unit and Mass Rearing Engineering Research Unit, SEA and Methods Development Unit, APHIS
Boll Weevil Research Laboratory
Mississippi State, Mississippi
Research Leader: James E. Wright

Team Members: Theodore B. Darich, Jack G. Griffin, Jack W. Haynes, Paul Koenig, Oliver H. Lindig, John R. McCoy, Carlton D. Ranney, Richard L. Ridgway, Jon Robertson, and Glenn Wygul

Superior Service Award "For discovery of and for pioneering the development of the sterility and mass rearing procedures of the boll weevil for utilization in the Boll Weevil Eradication Trial Program."

The boll weevil—a major pest of more than half the cotton acreage in the United States—causes an estimated 8 percent yield loss in cotton production and costs farmers more than $75 million in insecticides annually. This group developed technology necessary to mass rear and sterilize both sexes of the boll weevil—a goal that had been sought continuously for 15 years. Adult boll weevils were sterilized by a combination of gamma irradiation and an insect growth regulator that physiologically inhibits production of viable eggs. The group also evaluated behavioral factors, including pheremone production, mating, competitiveness, flight ability, sperm transfer, mortality, and performance with native boll weevils.

Evaluation in the laboratory and field demonstrated conclusively that the mass-reared adults were sterile and competitive with natural populations. In 1979, more than 13 million adults free from bacterial contamination were mass reared, sterilized, and released in the Boll Weevil Eradication Trial Program. Eradication of the boll weevil was originally advocated in 1958, but an initial experiment by another group from 1971 through 1973 was reported by the National Academy of Sciences to have "technical shortcomings, particularly in the degree of sterility and behavioral competitiveness."

In 1977, Wright and his group critically re-examined the boll weevil in order to develop improved methods of sterilization and mass-rearing—two objectives required for funding of future programs.

Accomplishment of both technological objectives, demonstrated by this group through the 1979 Boll Weevil Eradication Trial Program, affords an opportunity to reduce yield and economic losses that boll weevils inflict on this country's cotton crop.